Ecosystem-based Management as Part of a Marine Environmental Quality Approach in the Central Coast, British Columbia, Canada

Glen Jamieson
Fisheries and Oceans Canada, Pacific Biological Station, Nanaimo

Brenda Bauer
Fisheries and Oceans Canada, Port Hardy

Herb Vandermeulen
Fisheries and Oceans Canada, Ottawa

Abstract
In 2002, Fisheries and Oceans Canada (DFO) began to apply the ecosystem-based management approach developed at a national DFO workshop in 2001. Efforts have begun to determine from broader conceptual environmental objectives appropriate regionally-relevant operational, or MEQ, objectives, with associated indicators and reference points, that will be used in oceans management. From the broad conceptual objectives of conservation of species and habitat, we are defining MEQ objectives specific to BC coastal areas relating to biodiversity, productivity, and the physical and chemical properties of the ecosystem. Under each of these, further nested components were defined, utilising an 'unpacking' process that links the conceptual objectives to those suitable for operational management. For each nested component, a suite of biological properties or characteristics is considered that further describes the objective. Example indicators and reference points were also considered by operational objective, i.e. from the bottom up.

Although this effort is being implemented first in British Columbia on the Central Coast, we believe our experiences and the approach that we are advancing is also relevant to the Strait of Georgia and Puget Sound. We describe our progress to date, including our initial action plan and recommendations for further research, to further the implementation of ecosystem-based management.

Under the overarching objective of conservation of species and habitat, an ecosystem-based management (EBM) approach is the implementation of defined objectives related to monitoring and maintaining biodiversity, productivity and the physical and chemical properties of an ecosystem. EBM is now relevant, timely and necessary because in many environments, individual ecosystem components are presently being utilised, harvested or impacted without regard for the maintenance of the overall integrity of the overall ecosystem; and the scale of these impacts is now such that there is real danger of overall negative ecosystem change to the detriment of the well-being of humans.

As background, Canada's *Oceans Act,* passed in 1997*,* calls for:

1. the implementation of integrated management (IM) plans.
2. the development of a national system of marine protected areas (MPAs).
3. the establishment of marine environmental quality (MEQ) guidelines, objectives and criteria.

IM seeks to foster sustainable development while preserving ecosystem health; MPAs are to be established in areas where marine ecosystems, species, and habitats are in need of special protection (an ecosystem integrity approach); and an understanding of MEQ is required to ensure the sustainability of marine ecosystems that support ocean-related activities.

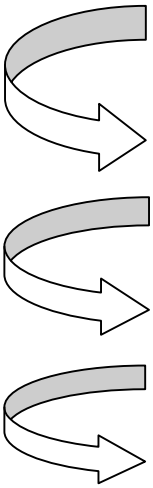
Most jurisdictions have already defined general "conceptual" management objectives, which are broad-based and widely understood by all. Examples are (1) to maintain the sustainability of human usage of environmental resources and, (2) to conserve species and habitats, including those other ecosystem components that may not be utilized by humans, either at this time or likely never. The challenge in EBM is to break conceptual objectives down into "operational" objectives that are useful, that can be measured, and that can be acted upon by resource managers in their managing of ocean activities. Operational objectives require defined indicators, reference points, and resultant management actions (verb) relative to these points.

As one moves from conceptual to operational objectives, the focus becomes more specific and detailed. It is necessary to specify some property of the ecosystem that can be measured as an indicator to support an operational objective. Some properties of the ecosystem that are of interest may not be directly measurable. For instance, spawning stock biomass might be the property of interest but we don't necessarily measure spawning stock biomass directly, but rather use an indicator of it, such as the abundance if age 3 fish (Table 1). In Table 2, we demonstrate how the process can be used with a habitat conservation conceptual objective.

Table 1. The process for the unpacking of a habitat conservation conceptual objective.

	What We Desire		**What We Can Measure**
	Conceptual Objectives	**Operational Objective**	**Indicators**
Objective ↙ objective ↙…	Maintain Productivity ↙ Trophic Transfers ↙ Forage Species ↙ Target Escapement ↙ (Maintain) Biomass	Consists of a Verb, Indicator and Reference Point, e.g., Maintain biomass of age 3 herring > 50,000 t	Abundance of age 3 herring

Table 2: An example of the unpacking of a habitat conservation conceptual objective.



High-level Policy Objective
(e.g., conserve biodiversity)

Next level of specificity: Biodiversity Conservation Objective
(e.g., maintain habitat structure and complexity within bounds of natural variability)

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Next level of specificity: Habitat Objective
(e.g., maintain critical rare and sensitive habitats)

In some cases, more than one indicator may be associated with a property of the ecosystem that is related to an operational objective. Some summarisation of these indicators may be required, perhaps through a modelling exercise. The value of defining ecosystem properties relevant to each operational objective is that they further describe the biological processes associated with the objective and guide choice of the appropriate indicators and reference points.

MEQ is as assessment of the state of the marine environment, including conditions resulting from human activities. MEQ science objectives for a certain area are thus developed at the same time as other management objectives (e.g. economic and social objectives). However, MEQ objectives are set with the long-term preservation of marine ecosystem structure and function in mind. Through MEQ, Science can provide advice relating to environmental values. Governance mechanisms are then needed to integrate social and economic values with biological values in order to identify MEQ priorities. Scale is also an important element, and priorities will shift between areas based on the above factors and the geographic scale under consideration.

The Canadian Working Group on Ecosystem Objectives (WGEO) was established to develop national ecosystem approaches to oceans management. The WGEO supported the "National Workshop on Objectives and Indicators for Ecosystem-based Management" (Jamieson et al. 2001), which reconfirmed that MEQ issues are related to all aspects of marine ecosystem structure and function. To involve a broad scientific group in the process of identifying overall British Columbian Central Coast MEQ conceptual objectives and to develop operational priorities appropriate for this geographical area, MEQ objectives for the area have been identified for both MPA and IM planning processes. Deliverables are agreed-on area conceptual objectives, identified expertise to develop them, and a process to both determine and evaluate the most important indicators from the unpacking exercise, and to incorporate these indicators into operational objectives.

Identified Central Coast priority conceptual objectives areas are to maintain populations to within bounds of natural variability, to maintain the functioning of key components of the ecosystem, to maintain principal ecosystem physical and chemical properties, and to identify and assess stressors to the ecosystem (risk assessment).

From the consultation process to date, we have learned that:

1. Development of operational objectives is most practically focused around either a specific geographical area (e.g. the Central Coast) or on an impacting economic sector (e.g. aquaculture, forestry, trawling, etc.).
2. There are potentially hundreds of operational objectives that can be derived from most conceptual objectives, and a process is required to establish priority areas, such as by known or anticipated impacting activities, etc.
3. It is important that the consultative process involve all research sectors (e.g. for marine stock assessments, with people from all relevant disciplines: shellfish, pelagics, groundfish; aquaculture, oceanography, etc.) or else important activities to monitor may be unintentionally excluded from consideration.
4. The process needs to be adaptive, in that one has to start somewhere, while recognising that changes will no doubt arise over time because of both logistic considerations and recognition that some data sets are proving to be functionally more useful than others.

With respect to the future, we plan to:

1. Have additional review of MEQ objectives options in the context of local resource managers' identified priorities, focusing on further development of suggestions made to date since we don't want to start from scratch again.
2. Identify opportunities for MEQ monitoring collaboration with other agencies, etc., and where possible, take advantage of them.
3. Develop recommendations for other specific indicators for MEQ objectives' monitoring, based on both the above and their cost-effectiveness, applicability and relevance to managers.

So, in conclusion, although this effort is being implemented first in British Columbia on the Central Coast, we believe our experiences to date and the approach that we are advancing is also relevant to the Strait of Georgia and Puget Sound to further the implementation of ecosystem-based management there.

References:

Jamieson, G., R. O'Boyle, J. Arbour, D. Cobb, S. Courtenay, R. Gregory, C. Levings, J. Munro, I. Perry and H. Vandermeulen. 2001. *Proceedings of the National Workshop on Objectives and Indicators For Ecosystem-based Management.* Canadian Science Advisory Secretariat Proceedings Ser. 2001/9: 142 p. (http://www.dfo-mpo.gc.ca/csas/Csas/English/Proceedings%20_Years/2001e.htm)

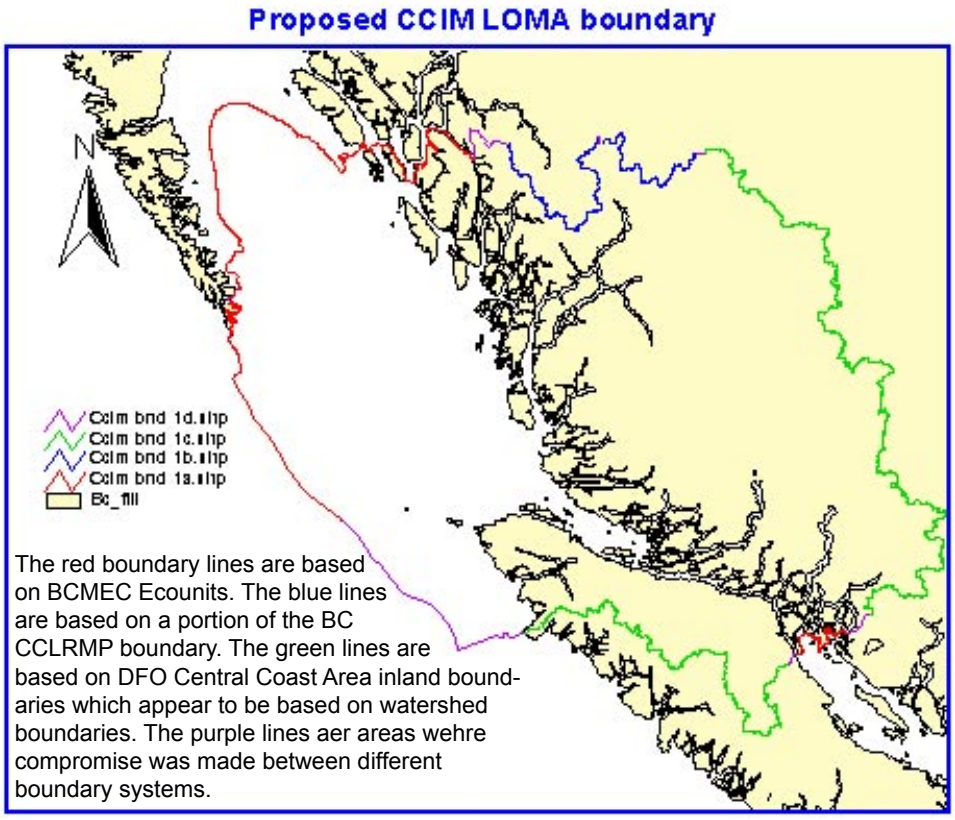

Figure 1. The potential Central Coast Integrated Management Large Ocean Management Area (CCIM LOMA), showing both marine and terrestrial watershed boundaries. The Outer boundary has yet to be finalised. CCLRMP = Central Coast Land and Coastal Resource Management Plan.